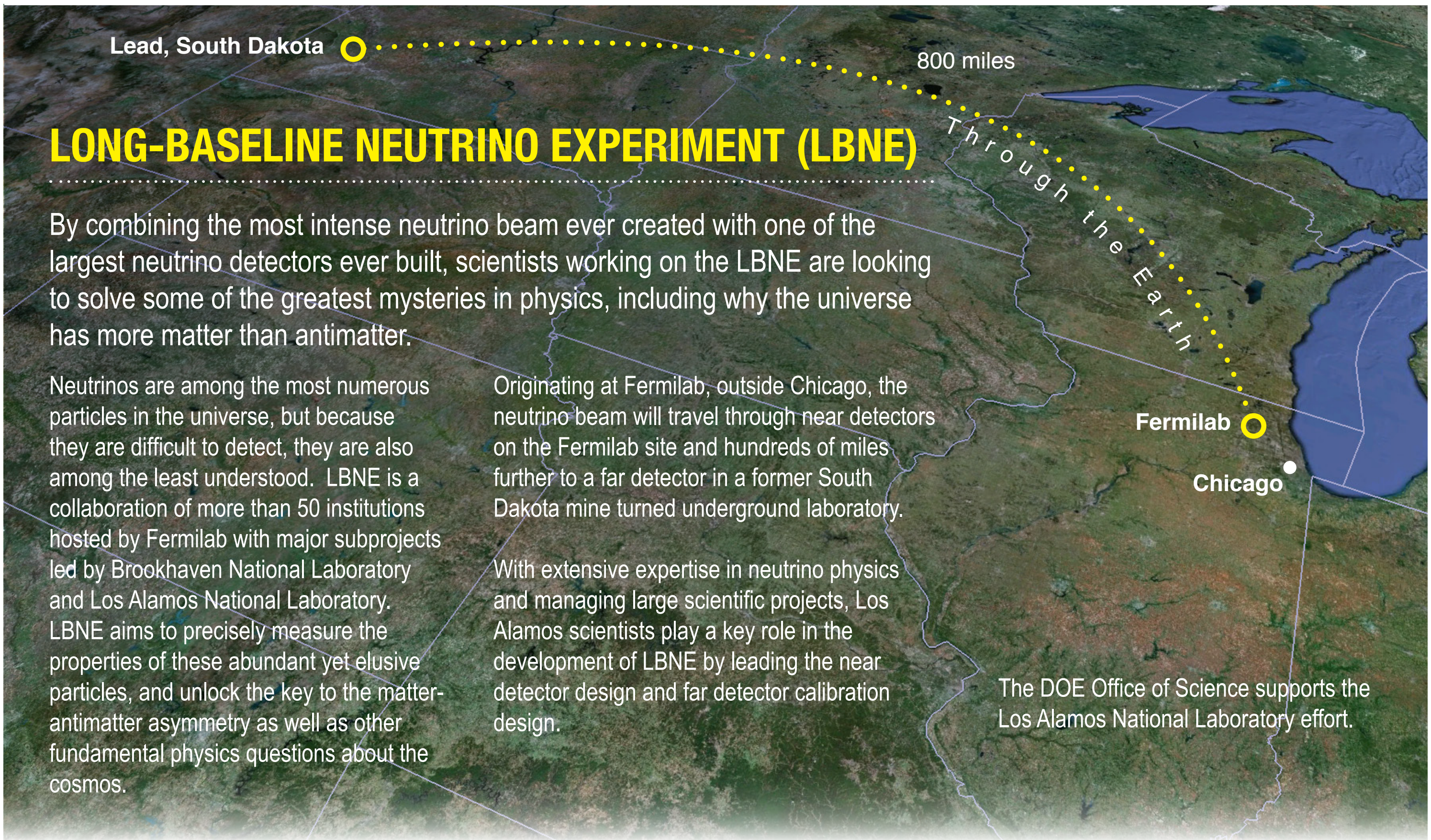


LONG-BASELINE NEUTRINO EXPERIMENT (LBNE)

By combining the most intense neutrino beam ever created with one of the largest neutrino detectors ever built, scientists working on the LBNE are looking to solve some of the greatest mysteries in physics, including why the universe has more matter than antimatter.

Neutrinos are among the most numerous particles in the universe, but because they are difficult to detect, they are also among the least understood. LBNE is a collaboration of more than 50 institutions hosted by Fermilab with major subprojects led by Brookhaven National Laboratory and Los Alamos National Laboratory. LBNE aims to precisely measure the properties of these abundant yet elusive particles, and unlock the key to the matter-antimatter asymmetry as well as other fundamental physics questions about the cosmos.

Originating at Fermilab, outside Chicago, the neutrino beam will travel through near detectors on the Fermilab site and hundreds of miles further to a far detector in a former South Dakota mine turned underground laboratory.

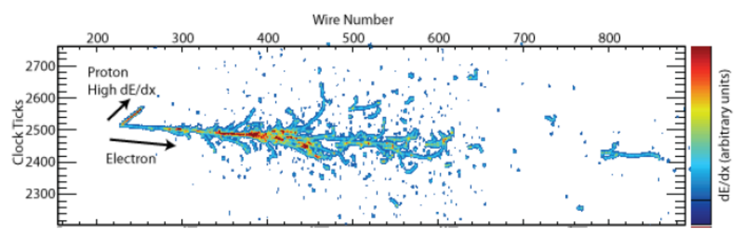
With extensive expertise in neutrino physics and managing large scientific projects, Los Alamos scientists play a key role in the development of LBNE by leading the near detector design and far detector calibration design.

The DOE Office of Science supports the Los Alamos National Laboratory effort.

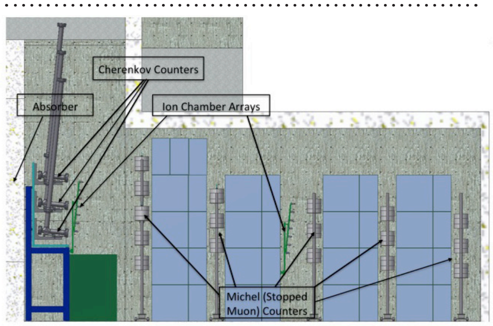
The surface non-uniformities, shown in the liquid argon in the Liquid Argon Purity Demonstrator at FermiLab, are due to liquid boiling at the liquid gas interface. As a medium for a time projection chamber, liquid argon must be pure at the level of about 0.1 parts per billion. At high levels of impurities, oxygen, water, or any other electronegative substance will absorb the freed electrons before they can reach the collection wires.

less than 100th of a sec

The time for particles, produced at the Fermi National Accelerator, to travel 800 miles through the earth to the Sanford Underground Research Laboratory.



At 10 kTons fiducial mass, the LBNE far detector will be the world's largest liquid argon time projection chamber, and will provide a three-dimensional view of events, such as this image of a charged current interaction, reconstructing the distance from the wire plane by the time it takes for the electron cloud to drift to the anode wires.



Conceptual design of LBNE near detector approved by the U.S. Department of Energy. The engineering design of the experiment is now underway.
(Figure: Geoff Mills, P-25, and Jan Boissevain)

2022 The year operations are planned to begin

Our scientists and engineers investigate the field of high energy physics through experiments that strengthen our fundamental understanding of matter, energy, space, and time.

For more information contact:

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HIGH-ALTITUDE WATER CHERENKOV GAMMA-RAY OBSERVATORY (HAWC)

With HAWC, a highly sensitive, all-sky survey instrument being built on the slopes of Mexico's highest peak, astrophysicists soon will have a new instrument for exploring the high-energy universe—and helping solve the century-old mystery of the origin of cosmic rays.

Scientists theorize that cosmic rays, high-energy particles moving through our galaxy from distant sources, might originate from supernovae, from quasars, or perhaps from other exotic, less-understood or yet-to-be-discovered sources within the universe. HAWC will detect the highest energy emission from these sources to study how nature accelerates particles to energies millions of times greater than man-made accelerators.

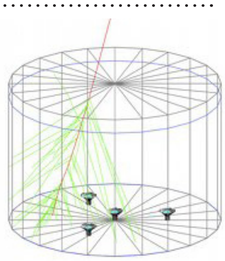
Los Alamos researchers are contributing their expertise in high-energy physics and program development to build and operate HAWC. The project is a collaboration of approximately 150 scientists from 16 U.S. universities, 14 Mexican universities, and Los Alamos National Laboratory (LANL).

The observatory builds on experience from Milagro, a LANL-based high-energy gamma-ray observatory that recorded more than 200 billion cosmic-ray collisions with the earth's atmosphere, producing the most detailed high energy map of the universe to date. HAWC's high altitude location and large physical area, coupled with recent advances in detector design, means it will detect gamma-ray sources with more than 15 times the sensitivity of Milagro.

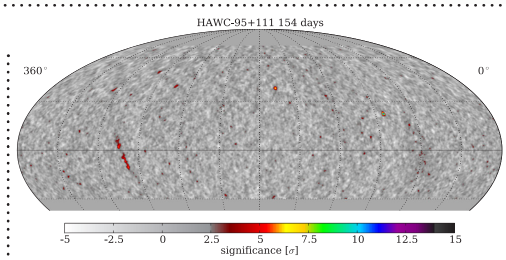
The DOE Office of Science supports the Los Alamos National Laboratory effort.

HAWC's Cherenkov detectors are corrugated steel tanks 4 meters high and 7.3 meters in diameter. Each tank contains 4 photomultiplier tubes, which are sensitive at ultraviolet wavelengths.

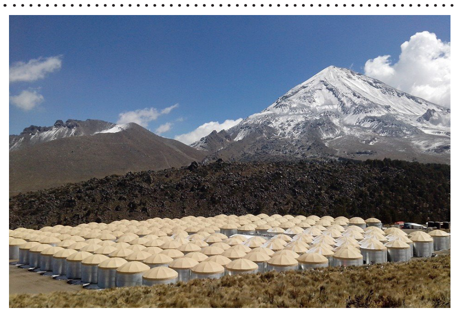
14k^ft^ **The elevation at which HAWC is being built.**



Simulation of a charged particle passing through a tank (red line) and emitting Cherenkov light (green lines). Scientists will study the recorded light to determine the direction of the original energetic particle as a means to discover the cosmic ray's source.

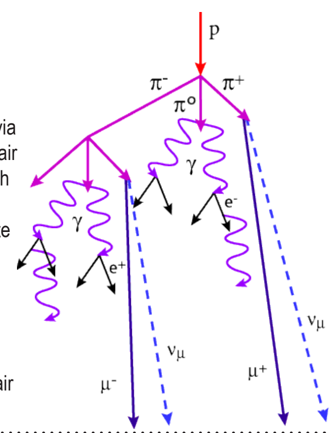


View of the tera-volt sky from 154 days of HAWC-111 data. HAWC has been operating for six months with 111 of 300 tanks operational and now detects the Crab Nebula, several active galaxies, and emission from the southern region of the Milky Way.



At HAWC's construction site near Mexico's Pico de Orizaba volcano 1,200 light-sensitive photomultiplier tubes are being placed in 300 water-filled tanks. The tubes will detect high-energy gamma rays as they interact in the atmosphere.

When a high-energy cosmic ray enters the atmosphere it loses its energy via interactions with air molecules. At high energies these interactions create particles. These new particles go on to create more particles in a process known as an extensive air shower.



Our scientists and engineers investigate the field of high energy physics through experiments that strengthen our fundamental understanding of matter, energy, space, and time.

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